Rylaarsdam 1983), although this is not always the case (Fitzhardinge 1985, Harriott 1985). Relative recruitment rates have been shown to vary from year to year, and among sites on the Great Barrier Reef (Wallace 1985 a).

There appears to be an inverse correlation between success of larval recruitment and propagation by fragmentation in some coral species (Kojis & Quinn 1981 b, Highsmith 1982, Wallace 1985 b). Sammarco (1985, 1987) reported that, while planular recruitment of *Acropora* spp. on the Great Barrier Reef is high, juvenile recruits are rare in the Caribbean and populations there are structured primarily by asexual processes. Temporal and regional variations in biotic and environmental factors can cause differences in reproductive and recruitment patterns of coral communities.

The pan-Pacific coral *Pocillopora damicornis* provides an example of how life history characteristics may vary with respect to local conditions (Richmond 1985, 1987 a). Enewetak Atoll and Hawaii are characterized as having low rates of predation on *P. damicornis*, relatively low seasonal variability, yet relatively high frequencies of mortality-causing disturbances (typhoons and winter storms). *P. damicornis* colonies planulate monthly throughout the year in Hawaii and the Central Pacific, and the oldest colonies observed are estimated to be less than 10 yr old (branch lengths < 20 cm). The eastern Pacific of Panama is characterized as having high rates of predation on *P. damicornis*, high levels of seasonal variability, and low frequencies of mortality-causing events. In this area, *P. damicornis* has never been found to release planulae, has a higher colony growth rate, and is the dominant coral in terms of competitive interactions with other corals, with some colonies estimated as over 70 yr old (branch lengths > 240 cm).

Theories on the evolution of life history characteristics have been proposed which suggest that under conditions of environmental instability, where lethal disturbances occur at a relatively high rate, formation of large numbers of motile propagules should occur, while under stable conditions, selection will favor clonal (asexual) growth (Williams 1975, Maynard-Smith 1978). Likewise, under conditions of low juvenile versus high adult mortality, and relatively low competitive ability versus competitive dominance, selection will favor the sexual mode (Abrahamson 1980, Douglas 1981). *Pocillopora damicornis* fits these predicted patterns over its distributional range.

RESOURCE MANAGEMENT IMPLICATIONS

As coral reefs throughout the world are showing signs of degradation, management of reef resources is becoming a growing concern. In the case of corals which spawn during a very brief period each year, the presence of contaminants such as petroleum products, pesticides, herbicides and heavy metals from soils may prevent successful fertilization of eggs by sperm, and hence, severely limit coral recruitment (Richmond unpubl.). It is suggested that pollution levels which may not affect adult coral colonies could still be responsible for the eventual loss of reefs if reproductive processes are disturbed. In Guam and in Okinawa (southern Japan), the peak coral spawning occurs during the rainy season, when levels of coastal contamination via runoff are at their highest (pers. obs.).

With reef degradation and destruction occurring on a global scale, an application of the reproductive data is in the area of reef recovery. Areas of reef which have been destroyed may be re-seeded, and the most efficient means will depend on local conditions. In areas where sedimentation is high, corallivores are present in large numbers, and/or disturbance rate is low, cementing larger numbers of smaller fragments may be more effective based on reproduction and recruitment data. In areas where environmental conditions support sexual reproduction of corals, juvenile mortality is expected to be relatively low, and suitable substratum is available, transplantation of gravid adult colonies into an area may result in highest return of effort. Reef re-seeding is an expensive process (Harriott & Fisk 1989) and management efforts might best be expended in coral reef protection and conservation.

SUMMARY

Data on the reproductive biology of 200+ scleractinian corals indicate several apparent trends. Species which broadcast spawn outnumber those which brood planula larvae. Broadcast spawners typically have limited, annual spawning periods, while most brooders are iteroparous, releasing larvae over a large part of the year. Most corals reported to date are hermaphroditic, some of which have been found to self-fertilize readily in the laboratory; the capacity for selfing is low to non-existent in other hermaphroditic species. There are reports of coral populations which are apparently sterile, particularly those at the extreme limits of their distributions.

There appear to be several geographical trends in coral reproduction. The majority of species on the Great Barrier Reef participate in an annual synchronous spawning event following full moon in the austral spring. In other areas of the Pacific, the Caribbean, and the Red Sea, there is a greater partitioning of spawning periods over more months, days, and lunar phases. Degree of synchrony among species may be related to seawater temperature ranges in each region.

Mode of reproduction within a given taxa is generally conservative, while timing may be variable within and among species. Differences in reproductive patterns may represent adaptations to local environmental conditions or may represent groups which have not been sufficiently taxonomically differentiated. A point which clearly emerges from the data reviewed in this paper is the need for examination of reproductive characteristics in conjunction with skeletal characters to elucidate what may be real problems in coral taxonomy. Do observed reproductive differences indicate that speciation has occurred among populations? If we accept the biological species definition, it is evident that morphological characters alone may fail to detect valid biological differences. As more studies of reproduction are pursued, resulting information will enable development of a more accurate understanding of the ecology and evolutionary biology of the Scleractinia.

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